

AD

TECHNICAL REPORT

73-39-FL

DEVELOPMENT OF SAUCE, GRAVY & SEASONING MIXES FOR MILITARY FOOD SYSTEMS

by

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Project Reference: 1J664713D548

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May 1973

UNITED STATES ARMY
NATICK LABORATORIES
Natick, Massachusetts 01760



Food Laboratory

FL-177

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FOREWORD

This report covers the development of dry sauce, gravy and seasoning mixes which were designed for ease and quickness of preparation and to meet the storage requirements of Armed Forces Food Service Systems.

These products offer increased shelf life, less shipping and storage space and above all, convenience of preparation.

These complete mixes require only the addition of milk or water and subsequent cooking as indicated in Limited Production Purchase Description LP/P DES 19-71. This development was undertaken under Project No. 1J664713D548, Military Subsistence System.

ACKNOWLEDGMENTS

The authors wish to acknowledge the assistance of Cpl Marc Taylor, Mrs. Judith S. Westerling, Acceptance Group, Pioneering Research Laboratories, Mr. Otto Stark and his staff, Food Chemistry Branch, NLABS, who conducted the sensory studies and the chemical analysis, respectively, for this project.

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ABSTRACT

A number of sauce, gravy and seasoning mixes, were developed for use as items of general issue for the Armed Forces. These mixes were packed in No. 2½ cans with 1 oz desiccant (CaO) bags. For comparison, similar mixes were packed in No. 2½ cans without desiccant. These products were packed in air with the exception of the spaghetti sauce mix which was packed in an atmosphere of nitrogen (less than 2.0% oxygen). The sauce and gravy mixes were stored at 37.7°C. and were evaluated and chemically analyzed initially and after 3 and 6 months storage. There was a corresponding increase in peroxide or free fatty acid content as moisture increased during storage at elevated (37.7°C.) temperatures. The product stability was directly affected by time and temperature of storage, and moisture contents.

INTRODUCTION

The Armed Forces Product Evaluation Committee requested Natick Laboratories to develop sauce, gravy and seasoning mixes which would have the attributes of convenience and stability for 6 months at 37.7°C or 2 years at 21°C.

Convenience foods have a broad definition depending upon the end-use for which they are intended. Generally, they are defined as foods which can be prepared quickly and easily with a minimum of labor.

Dry, free-flowing sauce, gravy and seasoning mixes developed by Natick Laboratories met the Armed Forces storage requirements as well as the requirement for ease of preparation. They require only the addition of milk or water and heating. A Limited Production Purchase Description, LP/P DES 19-71 was prepared based on the findings of this study.

EXPERIMENTAL PROCEDURES

The mixes were prepared according to formulas specified in Tables 1, 2 and 3, were air packed (except spaghetti sauce mix) in No. 2½ cans with and without desiccant bags. Since tomato powder is known to oxidize very rapidly under atmospheric conditions, it was decided to pack the spaghetti sauce mix in an atmosphere of nitrogen (less than 2.0% oxygen). The canned products were stored at 37.7°C., and were evaluated by a consumer panel and chemically analyzed initially and after 3 and 6 months.

The sensory method employed was a consumer type panel of thirty-two judges selected at random for each product and at withdrawal time from an untrained NLABS volunteer taste panel from the taste panel roster. Products were reconstituted with water or milk and heated as specified in LP/PD DES 19-71 (1). Subjects were instructed to indicate their opinions according to the 9-point Hedonic scale described by Peryam and Pilgrim (2). Each gravy or sauce was served over an appropriate food which was thought to represent a typical end-use in military food service. White sauce was served over mixed vegetables; cheese sauce over broccoli; mushroom, chicken, and brown gravies over mashed potatoes; and spaghetti sauce over spaghetti. Samples were presented one at a time. All tests were conducted in a laboratory area specifically designed for this purpose. Appropriate psychological controls, such as a balanced sample presentation order and taste booth partitions, were employed to avert bias and ensure independent judgements during the tests. Serving temperature for all products was at least 150°F. (65.6°C.).

For the analytical work, samples were tested for moisture content, and as applicable, % free fatty acids, and peroxide values. The following methods were employed: (a) free fatty acids were determined on chloroform extracted fat, as percent oleic acid in fat (b) peroxide value, milli-equivalents oxygen per kg. fat was determined by potassium iodide method and (c) moisture was determined by vacuum oven, 70°C., 8 hours.

RESULTS AND DISCUSSION

Table 4 and Figure 2 display the effects of storage time and temperature (37.7°C) on moisture content and % free fatty acids, initially and after 3 and 6 months storage with and without a desiccant. Table 4 and Figure 2 show that canned products packed without a desiccant produced a noticeable increase in % free fatty acid. The spaghetti, chicken gravy and barbecue without desiccant became very dark and caked by the third or sixth months, and as indicated in Table 5 were eliminated from consumer preference evaluation. Cans packed without desiccant developed noticeable distention of the ends. The distention was analyzed as being due to increased levels of CO₂.

Table 5 and Figure 1 give the consumer panel mean preference ratings, standard deviations and the least significant differences for sauce, gravy and seasoning mixes, as affected by various storage conditions. The results of the test show that the consumer preference for the products decreased when the products were stored without a desiccant. These changes in preference were dramatic in that some of the products, such as white sauce mix and barbecue sauce mix packed without a desiccant became unpalatable within 3 months storage at 37.7°C.

All products packed with desiccant, except the white sauce mix, showed no significant difference in acceptability after 3 or 6 months storage at 37.7°C. White sauce mix packed with a desiccant decreased in acceptability from a Hedonic rating of 6.7 initially to 5.2 after 6 months at 37.7°C. Without a desiccant, however, the preference ratings for the white sauce decreased from an initial 6.7 to 4.1 after storage at 37.7°C. for 6 months. As the product became less palatable it also developed a soapy taste. Initially, the commercially available white sauce mixes from the major processors rated in the range of 5.0 to 5.5 in Hedonic ratings.

The results of preference tests for Brown Gravy Mixes packed with or without a desiccant and subsequent storage at 37.7°C. for 6 months showed no significant difference in acceptability. It is possible that the brown gravy without desiccant was more stable than its counterpart in other Sauce and Gravy Mixes due to the presence of hydrolyzed vegetable protein (3) Bishov, *et al.*

The Taco Seasoning Mix was not placed in storage since it is similar to Chili Powder which had previously been found to be stable.

A split-plot analysis of variance of the Hedonic ratings of sauce and gravy mixes indicates that the length (months) of storage at 37.7°C. is significant for white sauce and the effect of packaging with a desiccant is significant for white sauce, cheese sauce and mushroom gravy. Although the analysis of variance did not show a significant effect for packaging with a desiccant for brown gravy, chicken gravy and spaghetti sauce mixes, actual observation of the latter two products packaged without a desiccant showed that they had darkened very markedly and were much poorer than the product packed with a desiccant.

CONCLUSION

The results of this study show that moisture, time and temperature are responsible for the deterioration of gravy, sauce and seasoning mixes. Stable, free flowing sauce, gravy and seasoning mixes capable of withstanding long term, elevated temperature (37.7°C) storage can be achieved by reducing the moisture content of these products to a low level (2.0 — 4.5%). This can be accomplished by in-package desiccation. The process involves packaging gravy, sauce and seasoning mixes in a hermetically sealed container with a desiccant.

The Limited Production Purchase Description LP/P DES 19/71 adopted the use of in-package desiccation as a means of extending the shelf life of these products. The document contains formulations of gravy, sauce and seasoning mixes which are easy to prepare and may be categorized as convenience foods. They are also designed for long shelf life.

Adoption of this Limited Production Purchase Description in the Armed Forces Food Service System will assure substantial savings through the use of products which are convenient, require less storage and shipping space and possess the capacity for extended shelf life.

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1. _____ Sauce, Gravy and Seasoning Mixes, Limited Production Purchase Description LP/P DES 19-71, 1971.
2. Peryam, D. R., and F. J. Pilgrim. 1957. Hedonic Scale Method of Measuring Food Preferences. Food Technol. 11, 9-14.
3. Bishov, S. J., Y. Masuoka and A. S. Henick. 1967. Fat Quality and Stability in Dehydrated Proteinaceous Food Mixes. Food Technol. 21, 148-150.

TABLE 1 — Formulations of Gravy Mixes

| <u>Ingredients</u> | Class 1 | Class 2 | Class 3 |
|--|--|---|---|
| | <u>Mushroom Gravy Mix</u> (% by weight) | <u>Chicken Gravy Mix</u> (% by weight) | <u>Brown Gravy Mix</u> (% by weight) |
| Wheat flour | 16.0 — 18.0 | 10.0 — 11.0 | 49.0 — 51.0 |
| Starch, modified | 13.0 — 15.0 | 18.0 — 19.0 | 8.0 — 12.0 |
| Onion powder | 1.5 | 2.0 | 1.0 |
| Pepper, white, ground | 0.1 | 0.1 | 0.005 |
| Buttermilk solids | — | 3.0 | — |
| Monosodium glutamate | 3.6 — 3.8 | 3.0 | 8.0 — 10.0 |
| Dextrin | — | 7.0 — 8.0 | — |
| Salt | 3.4 | 3.0 | 2.5 |
| Chicken Powder, dehydrated | — | 6.5 — 7.5 | — |
| Malic acid | — | 0.1 | — |
| Nonfat Dry Milk Solids | 30.0 — 34.0 | 19.0 — 21.0 | — |
| Chicken fat | — | 18.0 — 20.0 | — |
| Chicken flavor, imitation | — | as required | — |
| F&D Color #5 | — | 0.007 | — |
| Celery powder | 0.15 | — | 0.05 |
| Shortening | 4.5 | — | 10.0 — 12.0 |
| Caramel color | as required | — | as required |
| Mushroom powder | 7.0 — 9.0 | — | — |
| Mushroom diced | 4.0 — 6.0 | — | — |
| Mushroom, flavor | as required | — | — |
| Sodium caseinate | 2.0 — 3.0 | — | — |
| Hydrolyzed vegetable protein | 4.0 — 4.5 | 6.5 — 7.5 | 9.5 — 11.5 |
| Sugar | — | — | 4.0 — 5.0 |
| Paprika, ground | — | — | 0.4 — 0.6 |
| Beef extract product | — | — | 2.0 — 2.5 |
| Disodium inosinate and disodium guanylate | — | — | 0.03 — 0.05 |

TABLE 2 — Formulations of Sauce Mixes

| Ingredients | Class 1 | Class 2 | Class 3 | Class 4 |
|-------------------------------------|----------------------|----------------------|----------------------|----------------------|
| | Cheese Sauce | Spaghetti Sauce | White Sauce | Barbecue Sauce |
| | Mix (% by weight) | Mix (% by weight) | Mix (% by weight) | Mix (% by weight) |
| Flour, wheat | — | — | 14.0 — 15.0 | — |
| Tomato powder | — | 62.0 — 64.0 | — | 34.0 — 36.0 |
| Cheese, powdered (with color) | 25.0 — 27.0 | — | — | — |
| Cheese, powdered (without color) | 25.0 — 27.0 | 7.0 — 8.0 | — | — |
| Brown sugar | — | — | — | 9.0 — 11.0 |
| Starch, modified | 19.0 — 21.0 | 7.0 — 8.0 | 10.5 — 11.5 | 13.0 — 14.0 |
| Salt | 3.0 — 3.5 | 6.0 — 6.5 | 3.5 — | 7.5 — 8.5 |
| Dextrin | — | 4.0 — 6.0 | — | — |
| Hydrolyzed vegetable protein | — | 1.5 — 3.0 | — | — |
| Garlic powder | — | 0.5 | — | 0.1 |
| Red pepper powder | — | 0.1 | — | 0.02 |
| Sugar, Baker's Special | — | 4.5 | — | 20.0 — 22.0 |
| Monsodium glutamate | 2.5 | 0.25 | 3.5 — | — |
| Oregano powder | — | 0.1 | — | — |
| Onion, dehydrated, minced | — | 2.0 | — | — |
| Citric acid | — | 0.05 | — | 1.0 |
| Coloring (Roxanthin Red No. 10) | — | as required | — | as required |
| Basil, ground | — | 0.1 | — | — |
| Thyme, ground | — | 0.1 | — | — |
| Rosemary, ground | — | 0.1 | — | — |
| Marjoram, ground | — | 0.1 | — | — |
| Sodium diacetate | — | — | — | 1.0 |
| Cloves, ground | — | — | — | 0.05 |
| Onion, dehydrated, powdered | — | — | — | 5.9 |
| Allspice, ground | — | — | — | 0.03 |
| Pepper, black, ground | — | — | — 0.5 | 0.50 |
| Mustard, prepared | 0.25 | — | — | 3.7 |
| Vegetable shortening | — | — | 16.0 — 18.0 | 0.5 |
| Worcestershire powder | — | — | — | 3.5 — 4.5 |
| Whey powder | 19.0 — 21.0 | — | — | — |
| Flavor, cheese intensifier | as required | — | — | — |
| Pepper, white | — | — | 0.1 | — |
| Nonfat dry milk solids | — | — | 45.0 — 47.0 | — |
| Sodium caseinate | — | — | 1.0 — 2.0 | — |
| Flavor, butter, imitation | — | — | 0.4 | — |
| Mono & diglyceride | — | — | 1.5 | — |
| Dry-APO-caroten (10%) | as required | — | 0.003 | — |

TABLE 3 – Formulation of Taco Seasoning Mix

| <u>Ingredients</u> | <u>Taco Seasoning Mix</u> (% by weight) |
|---------------------------|--|
| Onion, toasted, chopped | 19.0 – 21.0 |
| Dextrin | 17.0 – 19.0 |
| Chili pepper, California | 9.0 – 11.0 |
| Paprika, ground | 5.0 – 7.0 |
| Monosodium glutamate | 7.0 – 9.0 |
| Salt | 14.0 – 15.0 |
| Starch, potato | 4.5 – 5.5 |
| Cayenne pepper, ground | 1.25 |
| Garlic powder | 4.0 – 6.0 |
| Oregano, ground | 5.2 – 6.0 |
| Cumin seed, ground | 5.0 – 6.0 |
| Citric acid | 1.0 |
| Flavor, tomato, imitation | as required |
| Turmeric, ground | as required |
| Sodium caseinate | as required |

TABLE 4

The Effect of 37.7°C. Storage Temperature on Moisture, Free Fatty Acids, and Peroxide Value on Gravy and Sauce Mixes Stored for 6 Months With and Without a Desiccant

| Product | Time/months | Desiccant | Moisture(%) | Free Fatty acids (%) | Peroxide Value |
|---------------------|-------------|-----------|-------------|----------------------|----------------|
| Mushroom Gravy Mix | 0 | W | 5.4 | 4.7 | — |
| | 3 | W | 3.2 | 5.4 | — |
| | 3 | W/O | 5.8 | 15.5 | — |
| | 6 | W | 3.0 | 5.2 | — |
| | 6 | W/O | 5.8 | 16.5 | — |
| | 6 | W/O | 5.8 | 16.5 | — |
| Chicken Gravy Mix | 0 | W | 5.3 | 2.2 | 1.5 |
| | 3 | W | 4.1 | 4.2 | 1.9 |
| | 3 | W/O | 5.3 | 7.0 | 2.5 |
| | 6 | W | 4.1 | 5.8 | 0.9 |
| | 6 | W/O | 5.5 | 11.7 | 1.5 |
| | 6 | W/O | 5.5 | 11.7 | 1.5 |
| Brown Gravy Mix | 0 | W | 5.9 | 2.0 | — |
| | 3 | W | 4.9 | 3.4 | — |
| | 3 | W/O | 6.5 | 5.8 | — |
| | 6 | W | 5.6 | 3.9 | — |
| | 6 | W/O | 6.7 | 6.8 | — |
| | 6 | W/O | 6.7 | 6.8 | — |
| Cheese Sauce Mix | 0 | W | 3.7 | 1.4 | — |
| | 3 | W | 2.0 | 1.1 | — |
| | 3 | W/O | 3.8 | 1.6 | — |
| | 6 | W | 2.0 | 1.4 | — |
| | 6 | W/O | 3.8 | 2.1 | — |
| | 6 | W/O | 3.8 | 2.1 | — |
| Spaghetti Sauce Mix | 0 | W | 2.4 | 2.1 | — |
| | 3 | W | 2.6 | 1.9 | — |
| | 3 | W/O | 2.7 | 2.9 | — |
| | 6 | W | 2.1 | 2.1 | — |
| | 6 | W/O | 3.0 | 3.6 | — |
| | 6 | W/O | 3.0 | 3.6 | — |
| White Sauce Mix | 0 | W | 3.2 | 1.0 | — |
| | 3 | W | 3.0 | 0.6 | — |
| | 3 | W/O | 4.1 | 2.9 | 1.9 |
| | 6 | W | 2.3 | 1.3 | 2.2 |
| | 6 | W/O | 3.7 | 2.8 | — |
| | 6 | W/O | 3.7 | 2.8 | — |
| Barbecue Sauce Mix | 0 | W | 2.0 | — | — |
| | 3 | W | 2.2 | — ¹ | — |
| | 3 | W/O | 4.0 | — | — |
| | 6 | W | 1.2 | — | — |
| | 6 | W/O | 2.9 | — | — |
| | 6 | W/O | 2.9 | — | — |

¹ Insufficient presence of fat in the mix to adequately perform the analysis on chloroform extraction.

TABLE 5

Mean Consumer Preference Ratings and Standard Deviations for
Seven Gravy or Sauce Mixes, Initially and After 3 and 6 months
Storage at 37.7°C.

| Product | Time/Months | Desiccant | Mean Preference Rating ¹ | Standard Deviation |
|---------------------|-------------|-----------|---|--------------------|
| Mushroom Gravy Mix | 0 (Initial) | W | 6.7 | 1.5 |
| | 3 | W | 6.6 | 1.5 |
| | 3 | W/O | 6.2 ² | 1.9 |
| | 6 | W | 6.7 | 1.4 |
| | 6 | W/O | 5.3 ² | 1.8 |
| Chicken Gravy Mix | 0 (Initial) | W | 7.0 | 1.2 |
| | 6 | W | 6.6 | 1.3 |
| | 6 | W/O | 6.4 (Brownish Discoloration) | 1.8 |
| Brown Gravy Mix | 0 (Initial) | W | 6.8 | 1.3 |
| | 3 | W | 6.5 | 1.6 |
| | 3 | W/O | 6.1 ³ | 1.8 |
| | 6 | W | 6.6 | 1.8 |
| | 6 | W/O | 6.5 | 1.7 |
| Cheese Sauce Mix | 0 (Initial) | W | 7.3 | 1.4 |
| | 3 | W | 7.3 | 1.1 |
| | 3 | W/O | 6.1 ⁴ | 2.0 |
| | 6 | W | 7.5 | 1.1 |
| | 6 | W/O | 6.1 | 2.0 |
| Spaghetti Sauce Mix | 0 (Initial) | W | 6.5 | 1.4 |
| | 3 | W | 6.5 | 1.4 |
| | 3 | W/O | Eliminated; caked | — |
| | 6 | W | 6.4 | 1.6 |
| | 6 | W/O | 5.8 ⁵ (Brownish Discoloration) | 1.8 |
| White Sauce Mix | 0 (Initial) | W | 6.5 | 1.5 |
| | 3 | W | 5.9 ⁶ | 2.0 |
| | 3 | W/O | 5.0 | 2.1 |
| | 6 | W | 5.2 | 2.0 |
| | 6 | W/O | 4.1 | 2.2 |
| Barbecue Sauce Mix | 0 (Initial) | W | 6.8 | 1.1 |
| | 3 | W | 7.2 | 1.2 |
| | 3 | W/O | Eliminated; can damaged | — |
| | 6 | W | 7.1 | 1.3 |
| | 6 | W/O | Eliminated; caked; discolored | — |

¹The 9— Category Hedonic Scale, scored from Dislike Extremely=1 to Neither Like Nor Dislike (Neutral)=5 to Like Extremely=9.

² Rated significantly lower than 4.4°C Control at times indicated.

³ Rated significantly lower than 4.4°C Control at 3 months only.

No significant preference for with vs without-desiccant samples at 3 or 6 months.

⁴ Significantly lower rated than both 4.4°C Control and 37.7°C w/desiccant samples at both 3 and 6 months.

⁵ Rated significantly lower than 4.4°C Control at six months.

⁶ With desiccant samples rated significantly higher than no desiccant samples but significantly lower than 4.4°C control at 3 and 6 months.

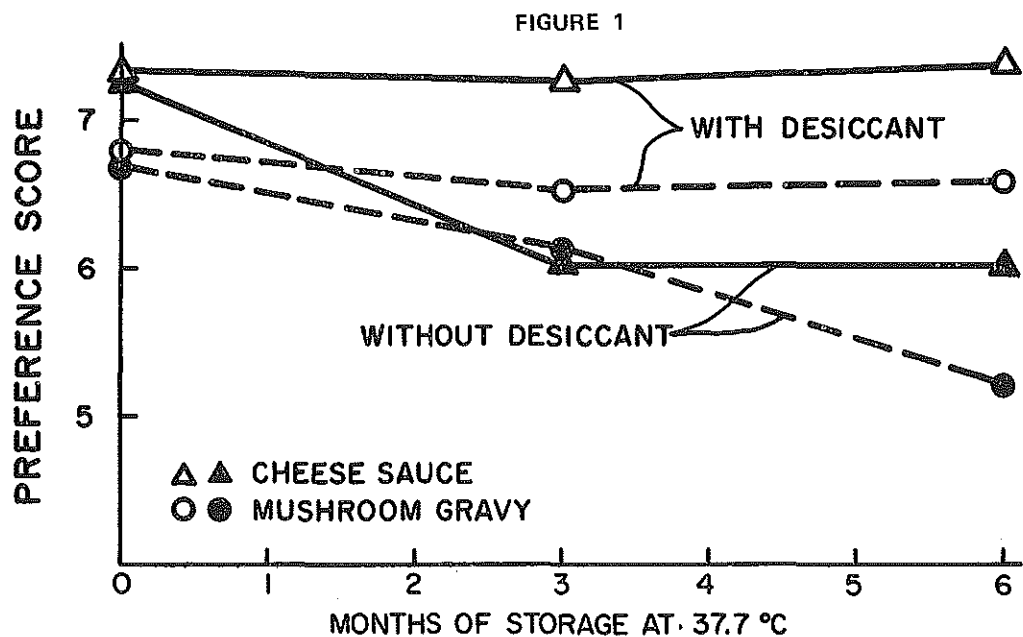


FIG. 1- CONSUMER PANEL PREFERENCE SCORES OF SAUCE AND GRAVY.

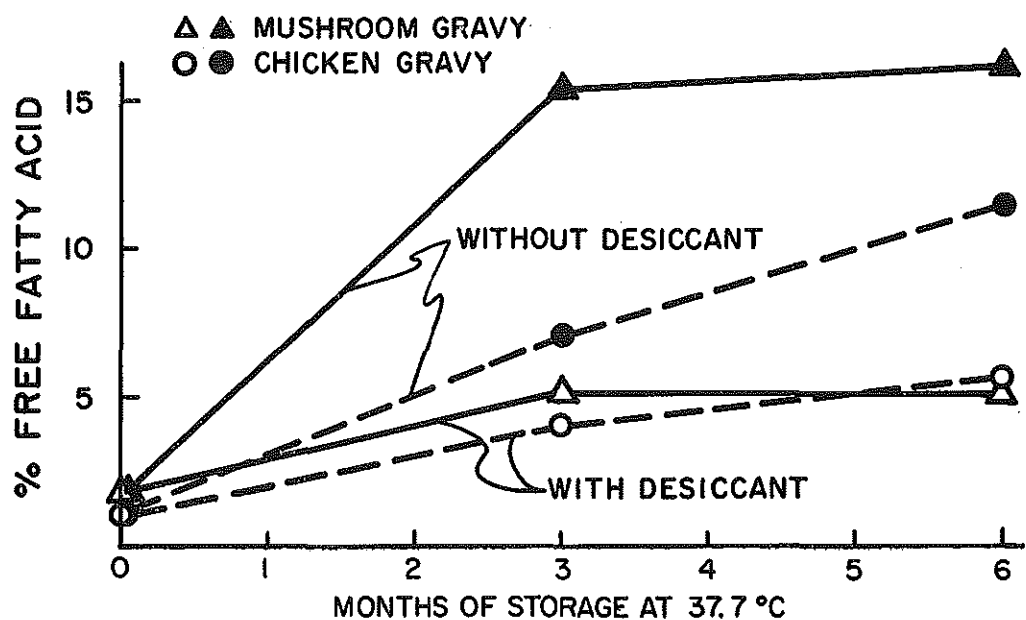


FIG. 2- % FREE FATTY ACID CONTENT OF GRAVY MIXES.

FIGURE 2

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Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

| | | | |
|---|--|--|--------------------------|
| 1. ORIGINATING ACTIVITY (Corporate author) US Army Natick Laboratories Natick, Massachusetts 01760 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified | |
| | | 2b. GROUP | |
| 3. REPORT TITLE Development of Sauce, Gravy and Seasoning Mixes for Military Food Systems. | | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) | | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Y. Masuoka, K. R. Johnson, I. T. Nii, A. R. Rahman and R. A. Kluter | | | |
| 6. REPORT DATE May 1973 | | 7a. TOTAL NO. OF PAGES 12 | 7b. NO. OF REFS 3 |
| 8a. CONTRACT OR GRANT NO. | | 9a. ORIGINATOR'S REPORT NUMBER(S) | |
| b. PROJECT NO. | | | |
| c. | | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) | |
| d. | | FL-177 | |
| 10. DISTRIBUTION STATEMENT This document has been approved for public release and sale; its distribution is unlimited. | | | |
| 11. SUPPLEMENTARY NOTES | | 12. SPONSORING MILITARY ACTIVITY US Army Natick Laboratories Natick, Massachusetts | |
| 13. ABSTRACT A number of sauce, gravy and seasoning mixes, were developed for use as items of general issue for the Armed Forces. These mixes were packed in No. 2½ cans with 1 oz desiccant (CaO) bags. For comparison, similar mixes were packed in No. 2½ cans without desiccant. These products were packed in air with the exception of the spaghetti sauce mix which was packed in an atmosphere of nitrogen (less than 2.0% oxygen). The sauce and gravy mixes were stored at 37.7°C. and were evaluated and chemically analyzed initially and after 3 and 6 months storage. There was a corresponding increase in peroxide or free fatty acid content as moisture increased during storage at elevated (37.7°C) temperatures. The product stability was directly affected by time and temperature of storage, and moisture contents. | | | |

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| 14. KEY WORDS | LINK A | | LINK B | | LINK C | |
|-------------------|--------|----|--------|----|--------|----|
| | ROLE | WT | ROLE | WT | ROLE | WT |
| Development | 8 | | | | | |
| Meat Sauce | 9 | | 7 | | | |
| Gravies | 9 | | 7 | | | |
| Seasonings | 9 | | 7 | | | |
| Mixtures | 9 | | 7 | | | |
| Dry | 0 | | | | | |
| General Foods | 4 | | | | | |
| Convenience Foods | 4 | | | | | |
| Armed Forces | 4 | | | | | |
| Oxygen | | | 6 | | | |
| Nitrogen | | | 6 | | | |
| Temperature | | | 6 | | | |
| Storage | | | 6 | | | |
| Moisture Content | | | 6 | | | |
| Time | | | 6 | | | |
| Desiccants | | | 6 | | | |
| Acceptability | | | 7 | | | |
| Palatability | | | 7 | | | |
| Stability | | | 7 | | | |

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